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CA 2426303 A1 2004/10/22

(21) 2 426 303

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2003/04/22

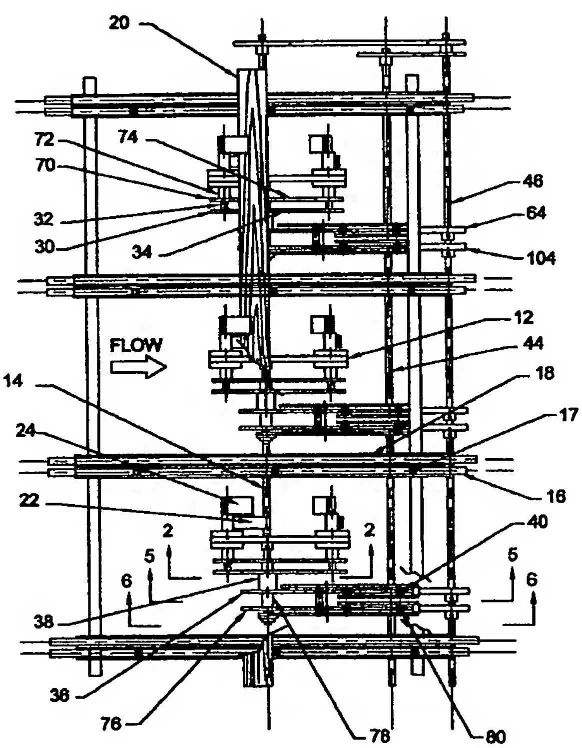
(41) Mise à la disp. pub./Open to Public Insp.: 2004/10/22

(51) Cl.Int.⁷/Int.Cl.⁷ B27B 31/04

(71) Demandeur/Applicant:
GRINDER, DANIEL A., CA

(72) Inventeur/Inventor:
GRINDER, DANIEL A., CA

(54) Titre : DISPOSITIF DE RETOURNEMENT ET D'ALIMENTATION DE PLANCHES
(54) Title: LUMBER TURNING AND FEEDING APPARATUS



(57) Abrégé/Abstract:
An apparatus for inverting boards or lumber while the boards are moving on a lugged transfer conveyor is disclosed. The Lumber Turning and Feeding Apparatus comprises one or more pair of rotatable gripping arms revolving about an eccentric axis, said gripping arms being manipulated by means of planetary drive mechanisms to cause the board to be retained between the pair of gripping arms while the board is inverted by the motion of the gripping arms. Furthermore, a substantially similar apparatus is disclosed adapted for the purpose of singulating boards from an infeed accumulated layer and depositing the boards individually into spaces between lugs on an outfeed lugged transfer conveyor.

ABSTRACT OF THE DISCLOSURE

An apparatus for inverting boards or lumber while the boards are moving on a lugged transfer conveyor is disclosed. The Lumber Turning and Feeding Apparatus comprises one or more pair of rotatable gripping arms revolving about an eccentric axis, said gripping arms being manipulated by means of planetary drive mechanisms to cause the board to be retained between the pair of gripping arms while the board is inverted by the motion of the gripping arms. Furthermore, a substantially similar apparatus is disclosed adapted for the purpose of singulating boards from an infeed accumulated layer and depositing the boards individually into spaces between lugs on an outfeed lugged transfer conveyor.

PATENT APPLICATION

INVENTION: LUMBER TURNING AND FEEDING APPARATUS

INVENTOR: DANIEL A. GRINDER

APPLICANT: DANIEL A. GRINDER

LUMBER TURNING AND FEEDING APPARATUS

Description

FIELD OF THE INVENTION

The present invention relates to a lumber turning apparatus for inverting lumber as it moves on a lugged transfer conveyor as are commonly in use in lumber mills today, consisting of a lugged transfer conveyor, a smooth speed-up conveyor, a turning mechanism, and a timing means to link the turning mechanism to the lugged transfer conveyor. The present invention further relates to a board feeding apparatus for dealing single boards from a layer of accumulated boards and placing single boards into spaces between spaced apart lugs on an outfeed lugged transfer conveyor.

BACKGROUND OF THE INVENTION

In the prior art, Canadian Patent application CA 2317370, Benoit Tremblay, laid open March 2, 2001 and Canadian Patent CA 2277720, Stuart Moore, issued August 28, 2001 both describe a board inverter wherein a freely rotating multi-lobed rotor acts upon a singulated board in cooperation with a specially shaped lug on an adjacent lugged conveyor to cause the board to be rotated in a forward direction with reference to the direction of travel of the lugged conveyor. The functional advantages of Tremblay's and Moore's board turners are described within the above noted patents. However, disadvantages to prior art board turners are overcome by embodiments of the present invention as described herein.

Prior art designs depend upon a lifting member to lift one edge of a board off of a lugged transfer conveyor and to rotate the board through a sufficient angle to cause the board to rotate over its center and complete the 180 degree rotation largely by the force of gravity and the board's own momentum. Some prior art designs make use of a second set of transfer conveyors running at a different speed from that of the lugged transfer conveyor,

and elevated slightly above the lugged transfer conveyor, so as to be in contact with the underside of the rotating board and to apply a frictional force on the underside of the board in a direction which enhances the rotation of the board. Some prior art designs include a let-down member such as the first lobe on the lifting member of Tremblay's board turner to lessen the impact of the board as it completes its rotation and lands on the transfer conveyor. Because boards are manufactured in a wide range of sizes and aspect ratios, (aspect ratio is defined herein as the ratio of board width divided by board thickness) the design shape of the lifting members and lugs on the lugged transfer conveyor is typically compromised to accommodate a wide range of lumber product sizes. Furthermore, in prior art board turners, because the boards are not positively retained as they are caused to rotate, the angular momentum acquired by the board as it rotates is not controlled fully enough to prevent near square boards with an aspect ratio approaching 1.0 from continuing to roll on the transfer conveyor after the initial 180 degree turn is complete. In practice, prior art board turners are carefully engineered to operate effectively within a limited range of board sizes and within a limited range of speeds. At times when the transfer conveyor is stopped and restarted, prior art board turners engineered to operate at high speed may jam or fail to complete the turning of boards during the low speed of a restart. Furthermore, crooked boards can easily stay on edge if they are not positively caused to turn completely, because a crooked board can be stable on its edge.

A need exists for a board turner which can operate reliably and unattended to turn boards 180 degrees as the boards pass through the area between two scanning optimizer units. As the board travels in a direction through the first scanner, the top surface and both edges are fully available to the scanning sensors. The board is rotated 180 degrees after passing the first scanner, and the second scanner senses the top surface of the board, which previously was on the bottom. Such scanning optimizer systems are typically applied to determine the grade or geometric features of finished lumber in a planer mill, and it is essential that the entire surface of each board be exposed to the scanning system. In planer mills, lumber is processed in batches such that during a production run all of the boards are the same width and thickness. The speed of the production line may

vary widely from one batch run to another depending on the dimensions of lumber being processed. Furthermore, it is most important that all sizes of boards having aspect ratios ranging from 1.0 to 12.0 be turned the required 180 degrees. Prior art board turners as described above cannot perform reliably enough under such a wide range of conditions to be operated unattended.

However, one prior art method of board turning is capable of the performance required for the dual scanning system described above. The boards are carried on a lugged transfer conveyor through the first scanner. Following this, the boards are carried around an array of overhead lugged wheels. The boards are held securely between the overhead wheels and a set of tensioned conveyors as the boards are carried 180 degrees around the wheel arrangement, thus causing the boards to be inverted with respect to their initial orientation. The boards are then released onto a second lugged transfer conveyor traveling in the opposite direction of the initial transfer conveyor, and some distance above the initial transfer conveyor. The second lugged transfer conveyor carries the boards through the second scanner. Although the above described prior art method is effective when incorporated into a new production line, it can be prohibitive to introduce such a system into an existing production line because it requires substantial additional space, a substantial change in elevation, and a complete reversal of product flow direction.

The apparatus of the present invention overcomes the deficiencies in prior art designs by providing full control of the rotation of the board by means of lifting and let-down members independently driven in time with the lugged conveyor transfer so as to positively retain both the bottom and top surfaces of the board throughout the turning motion. Furthermore the apparatus of the present invention provides for more than one set of lifting and let-down members to be mounted on a common rotating hub of geometry suited to the relative speed and spacing of lugs on the lugged transfer conveyor so that the lifting and let-down member assemblies revolve continuously about the common rotating hub at a speed in time with the lugged transfer conveyor. The apparatus of the present invention is advantageously compact and is compatible with typical lumber mill layouts.

SUMMARY OF THE INVENTION

The Board Turner Apparatus comprises:

an array of lifting members hereinafter referred to as leading arms;

an array of let-down members hereinafter referred to as trailing arms;

an array of rotatable hubs hereinafter referred to as turner hubs;

an array of lugged transfer conveyor runs;

an array of speed up conveyor runs;

a drive means for the rotating the turner hub;

a drive means for the leading arms;

a drive means for the trailing arms;

a drive means for the lugged transfer conveyor;

a drive means for the speed up conveyor;

a control means, either mechanical or electrical for coordinating the rotation of the leading arms;

a control means, either mechanical or electrical for coordinating the rotation of the trailing arms;

a support means;

In a preferred embodiment, an array of turner hubs of similar shape and size rotate on a common axis, lower than the lugged transfer conveyor. The axis of rotation of the turner arms lies in a substantially horizontal direction approximately perpendicular to the direction of travel of the lugged transfer conveyor. Boards lie spaced apart on the lugged transfer conveyor with the longitudinal axis of the boards approximately perpendicular to the direction of travel of the lugged conveyor transfer. The turner hubs are spaced apart

along their axis of rotation, and lie in a vertical plane perpendicular to their axis of rotation, and are rigidly attached to a common shaft hereinafter referred to as a turner shaft. Each turner hub includes at least one pivot bearing located near the circumference of the turner hub, and the pivot bearing serves to retain a leading arm, and a trailing arm. The leading arm and the trailing arm are rigidly attached to outer and inner concentric shafts respectively such that each arm may rotate independently within the pivot bearing. The leading arm and trailing arm are located on one side of the turner hub, and gears, hereinafter referred to as a leading planet gear, and a trailing planet gear are mounted on the opposite end of each respective concentric shaft. The leading planet gear and the trailing planet gear mesh with a leading sun gear and a trailing sun gear respectively, which are mounted on concentric hollow shafts, with bearings concentric with the turner shaft. The leading sun gear is attached to a leading driven sprocket by means of the leading hollow shaft, and the trailing sun gear is similarly attached to a trailing driven sprocket by means of a trailing hollow shaft, such that each of the two sun gears may be driven independently from each other and independently from the turner shaft. The leading drive chain for the leading sun gear is arranged so that the leading sun gear is driven at the same rotational speed as the turner shaft, and by means of a series of idlers and a pivoted mounting means for the idlers, the drive chain for the leading sun gear may be advanced or retarded with respect to the turner shaft while the leading sun gear and the turner shaft rotate continuously. Similarly, the trailing drive chain for the trailing sun gear is arranged so that the trailing sun gear is driven at the same rotational speed as the turner shaft, and by means of a series of idlers and a pivoted mounting means for the idlers, the drive chain for the trailing sun gear may be advanced or retarded with respect to the turner shaft while the trailing sun gear and the turner shaft rotate continuously. Through the above described drive configuration, the leading arm and trailing arm are caused to rotate on the axes of their concentric shafts with respect to the turner hub, the amount and timing of rotation being controlled by the advancement or retardation applied to their respective driven sprockets. The turner shaft and the drive chains for the sun gears are driven in time with the lugged transfer conveyor so that a leading arm and a trailing arm arrangement hereinafter referred to as a turning lobe, will come into approximately tangential alignment with the lugged transfer conveyor, and the turning lobe will follow a curved path in approximately the same direction as the direction of travel of a

lug on the lugged transfer conveyor, and the path of the turning lobe is timed advantageously to coincide with the location of a board traveling adjacent to the lug. At the time when the turning lobe approaches a turning position as described above, the drive chains for the sun gears are advanced or retarded as desired, and thereby cause the leading arm and trailing arm to rotate on their axes to perform the required coordinated motions. In this preferred embodiment, the drive chains are advanced or retarded by means of a leading cam and a trailing cam which are driven in time with the lugged transfer conveyor so that the leading cam and the turning cam make one revolution per lug space on the lugged conveyor transfer, and the leading cam and the turning cam cause a leading pivot frame and a trailing pivot frame to move idlers in the drive chain arrangement causing advancement or retardation of the sun gears with respect to the lugged transfer conveyor drive shaft and consequently with respect to the turner hub. In operation, the leading arm makes contact with the bottom face of the board near the board's leading edge and the leading arm rotates in a direction to lift the board off of the lugged transfer conveyor. Simultaneously, the trailing arm rotates to meet the top face of the board before the board rotates far enough to become unstable. The board is thus securely retained between the leading arm and the trailing arm as both arms continue to rotate in cooperation until the turning action is completed. The leading arm and the trailing arm are released from the board at or near the end of the turning action. In the preferred embodiment described above, a single turning lobe is described, and the tangential speed of the turning lobe may be greater than the speed of the lug on the lugged transfer conveyor, so that a board positioned on the leading side of the lug on the lugged transfer conveyor would be accelerated forward during the turning action, in the direction of travel of the lugged transfer conveyor, and the board is inverted in a backward direction with respect to the direction of travel of the lugged transfer conveyor, so that the board is replaced onto the lugged transfer conveyor within the same lug space.

In a second preferred embodiment of the present invention, three turning lobes are mounted on turner hub. The turner hub is driven in time with the lugged transfer conveyor at a speed such that one rotation of the turner hub is equal to the passage of three lugs on the lugged transfer conveyor. An array of speed up conveyor runs is mounted adjacent to

the runs of the lugged transfer conveyor and slightly higher than the lugged transfer conveyor runs so that the speed up conveyor carries the boards and holds the boards against the trailing side of the lugs on the lugged transfer conveyor. In this second preferred embodiment, the tangential speed of the turning lobe is approximately equal to the speed of the lug on the lugged transfer conveyor and the board, when inverted, is placed within its same lug space, but at a location following its position prior to being turned. Advantages of the second preferred embodiment are lower tangential speed of the turning lobe which provides gentler handling of the board, and greater tolerance for a wide board to be turned within a given lug space.

In both the first and second preferred embodiments of the present invention as described above, the rotation of the leading arm and the trailing arm relative to the turner hub is controlled by means of rotary cams and pivoted drive chain mounting arrangements. The the cam follower on the pivoted drive chain arrangement is held in contact with the rotating cam by means of a compressible actuating means such as an air cylinder. It is possible and advantageous to configure the pivoted drive chain arrangement such that the cam follower may lift away from the rotary cam against the force of the air cylinder at times when the leading arm and the trailing arm are held apart by a thicker board. With such an arrangement of the drive chains and cams, it is possible to selectively inhibit the turning action at any time by reversing the force exerted by the air cylinder, thereby holding the cam follower completely away from the cam, and thus keeping the leading arm and the trailing arm in a fully retracted position out of the path of the board.

It can be understood from the above descriptions that by altering the pattern of rotary motion of the leading and trailing arms, it is possible to use the board turning apparatus of the present invention to turn boards 90 degrees instead of a full 180 degrees. This can be advantageous for the purpose of manually grading square boards where each face of the board is to be viewed, and a series of board turners may be used in a sequential arrangement.

It can be further understood that the mechanically timed drive chains, cams, and advancing and retarding means described above could be replaced by powered drive means and actuators such as electric or hydraulic motors and actuators controlled by electronic speed and multi-axis motion control systems commercially available and in common use for similar purposes in the lumber manufacturing industry.

It is an object of this invention to provide a board turning apparatus with the following advantages over prior art:

a) Suitable for retro-fit to existing lumber production lines without significant modifications to existing or adjacent equipment.

b) Reliable and consistent 180 degree or 90 degree turning of boards.

c) Ability to handle the full range of board sizes and aspect ratios.

d) Ability to handle curved and crooked boards.

e) Ability to turn boards effectively at high speeds and throughout a wide range of speeds.

In a third preferred embodiment of the present invention, the board turning device is configured to operate as a lug loader or a combination lug loader and board turner in such a way that a board is plucked from a stationary position on a smooth top conveyor and deposited into a space between two lugs on a downstream lugged transfer conveyor. The lug loader of this third preferred embodiment may be adapted to operate either as a simple lug loader to deal boards directly into lug spaces without inverting the boards, or as a combination lug loader and board turner to invert each board concurrently as the board is dealt from a stationary position on a smooth top conveyor and deposited into a space between two lugs on a downstream lugged transfer conveyor. When used as a simple lug loader, the board turning device has the capability of operating at very high speeds with positive acceleration provided by the leading arm and trailing arm gripping both the top and bottom surfaces of the board, comparable in performance with the best known art lug loaders. When used as a combination lug loader and board turner, the board turning device plucks a board from a stored layer, inverts the board, thus exposing all four faces

of the board to a grader, and deposits the board into a lug space in a single operation. Prior art devices designed to perform the function of a combination lug loader and board turner fall into two basic categories. The first category of such prior art devices is commonly known as a "pass-turn" device. Pass-turn devices of known art comprise a board singulator, a downwardly sloped skid, a stopping tab, a flipper arm, and a lugged outfeed conveyor. Pass-turn devices require much operator involvement and are consequently limited to very low speed operation. Furthermore, due to the need for sloping skids, pass-turn devices are not easily retrofitted to existing production lines. The second category of prior art combination lug loader and board turner are commonly referred to as "multiple grade stations". In a multiple grade station, a layer of boards on an infeed conveyor is diverted in batches to two or more flow paths, each flow path containing an accumulation conveyor, a lug loader, a lugged transfer conveyor, a board turning device integral with the lugged transfer conveyor, and a merging system to deposit the boards from each multiple grade station onto a common lugged transfer conveyor which accepts boards from all of the multiple grade stations and transports the boards to a downstream process. Multiple grade stations of the type described above are costly and require substantial space due to the separation of the lug loader from the board turner.

It is an object of this third embodiment of the present invention to provide a lug loader or a combination lug loader and board turning apparatus with the following advantages over prior art:

a) Capable of high speed operation,

b) Not requiring a difference in elevation of the infeed and outfeed transfer conveyors,

c) Compact dimensions,

d) Inexpensive to manufacture due to its dual purpose capability.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood by reference to the accompanying drawings, wherein:

Fig. 1 depicts a plan view according to a second preferred embodiment of the board turner apparatus of the present invention.

Fig. 2 is an elevation view along section line 2-2 in Fig. 1.

Fig. 3 is an elevation view as in Fig. 2, depicting another stage in the operation.

Fig. 4 is an elevation view as in Fig. 2, depicting another stage in the operation.

Fig. 5 is an elevation view along section line 5-5 in Fig. 1.

Fig. 6 is an elevation view along section line 6-6 in Fig. 1.

Fig. 7 is an elevation view depicting a third preferred embodiment of the combination lug loader and board turner of the present invention, excluding drive details which are depicted in Fig. 5 and Fig. 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As best seen in Fig. 1 and Fig. 2, according to a second preferred embodiment of the present invention, three turning lobes 10 are mounted on each turner hub 12. The turner hub 12 is mounted on a turner shaft 14, and is driven in time with the lugged transfer conveyor 16 at a speed such that one rotation of the turner hub 12 is equal to the passage of three lugs 17 on the lugged transfer conveyor 16. An array of speed up conveyor runs 18 is mounted adjacent to the runs of the lugged transfer conveyor 16 and slightly higher than the lugged transfer conveyor 16 so that the speed up conveyor 18 carries the board 20 and holds the board 20 against the trailing side of the lugs 17 on the lugged transfer conveyor 16. In Fig. 2, turning lobe 10 is in a starting position. Leading arm 22 is shown in Fig. 2 in a retracted position as the leading arm 22 is brought to bear against the underside of the board 20 by the rotation of the turner hub 12. A trailing arm 24 is in an extended position so as to meet the topside of the board 20 as the leading arm 22 begins to lift the board 20 off of the speed-up conveyor runs 18. The board 20 is thus gripped securely between the leading arm 22 and the trailing arm 24, such grip being maintained

by the independently controlled rotary motion of the leading arm 22 and the trailing arm 24 as the leading arm 22 and the trailing arm 24 continue to rotate in a counter-clockwise direction. The lugged transfer conveyor 16 continues to advance at a constant speed and the turner hub 12 continues to rotate in a clockwise direction, until the board 20 has rotated approximately 180 degrees to a position as depicted in Fig. 3. The leading arm 22 then rotates quickly to a retracted position as depicted in Fig. 4, and the trailing arm 24 rotates slowly to a retracted position so as to release the board 20 gently onto the speed-up conveyor 18. With the leading arm 22 and the trailing arm 24 in retracted positions, the turner hub 12 continues to rotate with the leading arm 22 and the trailing arm 24 clear of board 20 until the next turning lobe 10 reaches a starting position.

In Fig. 5, trailing planet gear 30 is connected to trailing arm 24 by an inner planet shaft 32. Trailing planet gear 30 meshes with trailing sun gear 34. Trailing sun gear 34 is connected to trailing driven sprocket 36 by an outer sun shaft 38. Trailing driven sprocket 36 is driven by trailing driver sprocket 40 by means of trailing drive chain 42. Trailing driver sprocket 40 is mounted on jack shaft 44 driven in time with the lugged transfer conveyor headshaft 46 by means not shown, so as to cause trailing sun gear 34 to rotate at the same rotational speed as the turner hub 12. The trailing drive chain 42 is routed so as to pass around trailing idlers 50, 52, 54, and 56. Trailing idlers 52 and 54 are mounted to a fixed support 58 in common with turner shaft 14. Trailing idlers 54 and 56 are mounted to a trailing pivoted support 60 whose pivot axis is in common with the axis of jack shaft 44. A trailing cam follower 62 is mounted to the trailing pivoted support 60 in a location so that a trailing cam 64, mounted on the lugged transfer conveyor headshaft 46, makes working contact with trailing cam follower 62. Trailing actuator 66 applies a force against the trailing pivoted support 60 so as to cause trailing cam follower 62 to maintain contact with the profiled surface of trailing cam 64. In fig. 5, it can be seen that the pivoted support 60, when rotated about its pivot axis will cause the trailing driven sprocket 36 to be advanced or retarded with respect to the trailing driver sprocket 40. But because the trailing driver sprocket 40 is driven in time with the turner shaft 14 on which the turner hub 12 is mounted, rotation of the trailing pivot support 60 will result in a change in the phase relationship of the trailing sun gear 34 and the turner hub 12, thus causing the trailing arm

24 to rotate by an amount proportional to the change in phase between trailing sun gear 34 and the turner hub 12.

In Fig. 6, leading planet gear 70 is connected to leading arm 22 by an outer planet shaft 72. Leading planet gear 70 meshes with leading sun gear 74. Leading sun gear 74 is connected to leading driven sprocket 76 by an inner sun shaft 78. Leading driven sprocket 76 is driven by leading driver sprocket 80 by means of leading drive chain 82. Leading driver sprocket 80 is mounted on jack shaft 44 driven in time with the lugged transfer conveyor headshaft 46 by means not shown, so as to cause leading sun gear 74 to rotate at the same rotational speed as the turner hub 12. The leading drive chain 82 is routed so as to pass around leading idlers 90, 92, 94, and 96. Leading idlers 92 and 94 are mounted to a fixed support 58 in common with turner shaft 14. Leading idlers 94 and 96 are mounted to a leading pivoted support 100 whose pivot axis is in common with jack shaft 44. A leading cam follower 102 is mounted to the leading pivoted support 100 in a location so that a leading cam 104, mounted on the lugged transfer conveyor headshaft 46, makes working contact with leading cam follower 102. Leading actuator 106 applies a force against the leading pivoted support 100 so as to cause leading cam follower 102 to maintain contact with the profiled surface of leading cam 104. In fig. 6, it can be seen that the pivoted support 100, when rotated about its pivot axis will cause the leading driven sprocket 76 to be advanced or retarded with respect to the leading driver sprocket 100. But because the leading driver sprocket 100 is driven in time with the turner shaft 14 on which the turner hub 12 is mounted, rotation of the leading pivot support 100 will result in a change in the phase relationship of the leading sun gear 74 and the turner hub 12, thus causing the leading arm 24 to rotate by an amount proportional to the change in phase between leading sun gear 74 and the turner hub 12.

Fig. 7 depicts a third preferred embodiment of the present invention, wherein the boards 20 accumulate on an accumulation transfer 118 and are retained in a loading position by a lumber stop 120. Leading arm 122 is shown in a position where leading arm 122 makes contact with the underside of board 20. Trailing arm 124 is simultaneously brought to bear

against the topside of board 20 and board 20 is thus engaged and gripped securely between leading arm 122 and trailing arm 124. As the board 20 begins to be lifted and pulled in a forward direction by the leading arm 122 and trailing arm 124, the lumber stop 120 rotates forward and downward to allow the board 20 to pass clear of the lumber stop 120. When the board 20 has cleared the lumber stop 120, the lumber stop 120 returns to an upright position to retain the following board 20 in a loading position. In a simple lug loader application, the leading arm 122 and the trailing arm 124 carry the board forward by the rotation of turner hub 12, maintaining a substantially horizontal orientation of the leading arm 122 and the trailing arm 124 during the entire movement of the board 20 from the loading position to a loaded position on a lugged outfeed transfer conveyor 126 between two lugs 127. As the board 20 is deposited onto the lugged outfeed transfer conveyor 126, trailing arm 124 rotates quickly to a retracted position so as to cause the following trailing arm 124a to clear the leading edge of the board 20, and leading arm 122 rotates slowly to a position whereby the leading arm 122a on the following turning lobe 10a is in a correct position to make contact with the board 20. In a combination lug loader and board turner application, the board 20, after being engaged by the leading arm 122 and trailing arm 124, is inverted in a forward direction, and is deposited into a space between two lugs 127 on the lugged outfeed transfer conveyor 126. As the board 20 is deposited onto the lugged outfeed transfer conveyor 126, trailing arm 124 rotates quickly to a retracted position so as to cause the following trailing arm 124a to clear the leading edge of the board 20, and leading arm 122 rotates slowly to a position whereby the leading arm 122a on the following turning lobe 10a is in a correct position to make contact with the board 20.

As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the spirit or scope thereof. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

Claims

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A pair of elongate arms, hereinafter referred to as a leading arm and a trailing arm, pivotally mounted on a generally disc shaped turning hub wherein the pivot axis of the leading arm and the pivot axis of the trailing arm are not at the center of rotation of the turning hub, and a drive means for causing the leading arm to rotate individually on its pivot axis, and a means for causing the trailing arm to rotate individually on its pivot axis, while the leading arm and the trailing arm revolve about the center of rotation of the turning hub as the turning hub rotates on its center of rotation on a turning shaft, comprising:

(a) said leading arm,

(b) said trailing arm,

(c) said turning hub,

(d) said drive means for causing the leading arm to rotate on its pivot axis,

(e) said drive means for causing the trailing arm to rotate on its pivot axis,

(g) a lugged conveyor transfer of known art mounted adjacent to the apparatus of the present invention,

(f) a drive means for causing the turning hub to rotate in synchronized timing with the adjacent lugged conveyor,

(g) a means for controlling the rotation of the leading arm and the trailing arm in timed sequence synchronous with the rotation of the rotatable hub,

(h) said turning shaft,

(i) a pivot shaft,

(j) and a support frame.

2. The device of claim 1 wherein the leading arm makes contact with the under side of a board traveling on the adjacent lugged conveyor, and wherein the leading arm applies sufficient force to lift the board off of the lugged conveyor.

3. The device of claim 2 wherein the trailing arm makes contact with the upper side of the board while the leading arm lifts the board off of the lugged transfer conveyor, thereby causing the board to be retained between the leading arm and the trailing arm as the leading arm and the trailing arm are further rotated in cooperation causing the board to be retained between the leading arm and the trailing arm as the board is rotated through a desired angle of rotation.

4. The device of claim 3 wherein the leading arm and the trailing arm are released from contact with the board after the board has been substantially rotated through the desired rotation.

5. The device of claim 4 wherein the leading arm comprises an elongate member attached to a leading pivot shaft, a leading planet gear attached to the pivot shaft, and a leading bearing mounted on the turning hub, wherein the axis of the leading pivot shaft is approximately parallel with the axis of rotation of the turning hub, and the axis of the leading pivot shaft is eccentric to the axis of rotation of the turning hub.

6. The device of claim 4 wherein the trailing arm comprises an elongate member attached to a trailing pivot shaft, a trailing planet gear attached to the trailing pivot shaft, and a trailing bearing mounted on the turning hub, wherein the axis of the trailing pivot shaft is approximately parallel with the axis of rotation of the turning hub, and the axis of the trailing pivot shaft is eccentric to the axis of rotation of the turning hub.

7. The device of claim 5 wherein a leading sun gear is located concentric with the axis of rotation of the turning hub, and wherein the teeth of the leading sun gear mesh with the teeth of the leading planet gear, and wherein the leading sun gear is mounted rigidly in common with a leading driven sprocket, and wherein the leading sun gear and the leading driven sprocket are supported by a bearing concentric with the axis of rotation of the turning hub.

8. The device of claim 6 wherein a trailing sun gear is located concentric with the axis of rotation of the turning hub, and wherein the teeth of the trailing sun gear mesh with the teeth of the trailing planet gear, and wherein the trailing sun gear is mounted rigidly in common with a trailing driven sprocket, and wherein the trailing sun gear and the trailing driven sprocket are supported by a bearing concentric with the axis of rotation of the turning hub.

9. The devices of claims 7 and 8 wherein the leading pivot shaft is concentric with the trailing pivot shaft, and the leading pivot shaft comprises a hollow shaft within which the trailing shaft is mounted, and a trailing bearing is comprised of a bearing between the hollow leading shaft and the trailing shaft.

10. The devices of claims 7 and 8 wherein the trailing pivot shaft is concentric with the leading pivot shaft, and the trailing pivot shaft comprises a hollow shaft within which the leading shaft is mounted, and the leading bearing is comprised of a bearing between the hollow trailing shaft and the leading shaft.

11. The device of claim 7 wherein the leading driven sprocket is driven via a leading drive chain, and wherein the leading drive chain is routed around idlers, and wherein at least one of the idlers is mounted to a fixed support, and wherein at least one of the idlers is mounted to a leading pivot frame, and wherein a leading driver sprocket is centered on the pivot axis of the leading pivot frame, and wherein the arrangement of idlers is such that the leading pivot frame may be rotated about the pivot axis without significantly increasing or decreasing the slack in the leading drive chain and such that rotation of the leading pivot frame causes the leading driven sprocket to be advanced or retarded with respect to the leading driver sprocket.

12. The device of claim 8 wherein the trailing driven sprocket is driven via a trailing drive chain, and wherein the trailing drive chain is routed around idlers, and wherein at least one of the idlers is mounted to a fixed support, and wherein at least one of the idlers is mounted to a trailing pivot frame, and wherein a trailing driver sprocket is centered on the pivot axis of the trailing pivot frame, and wherein the arrangement of idlers is such that the trailing pivot frame may be rotated without significantly increasing or decreasing the slack in the trailing drive chain and such that rotation of the trailing pivot frame causes the trailing driven sprocket to be advanced or retarded with respect to the trailing driver sprocket.

13. The device of claim 11 wherein a leading cam is located so that the profiled surface of the leading cam makes slideable contact with the leading pivot frame such that as the leading cam rotates, the leading pivot frame is caused to rotate about the pivot axis of the leading pivot frame by an amount proportional to the radius of the leading cam profile, and wherein the leading cam rotates in synchronous time with lugs on the adjacent lugged transfer conveyor.

14. The device of claim 12 wherein a trailing cam is located so that the profiled surface of the trailing cam makes slideable contact with the trailing pivot frame such that as the trailing cam rotates, the trailing pivot frame is caused to rotate about the pivot axis of the trailing pivot frame by an amount proportional to the radius of the trailing cam profile, and

wherein the trailing cam rotates in synchronous time with lugs on the adjacent lugged transfer conveyor.

15. The device of claim 13 wherein a means for applying a force against the leading pivot frame, is attached to the leading pivot frame so as to cause the leading pivot frame to be forced into contact with the leading cam.

16. The device of claim 14 wherein a means for applying a force against the trailing pivot frame, is attached to the trailing pivot frame so as to cause the trailing pivot frame to be forced into contact with the leading cam.

17. The devices of claims 13 and 14 wherein the means for applying torque comprises an air cylinder.

18. The devices of claims 13 and 14 wherein the means for applying torque comprises a hydraulic cylinder.

19. The devices of claims 13 and 14 wherein the means for applying torque comprises a mechanical spring.

20. The devices of claims 13 and 14 wherein the means for applying torque comprises a balance weight.

21. The devices of claims 13 and 14 wherein the means for applying torque comprises a flexible bellows air actuator commonly referred to as an air spring.

22. The devices of claims 1 to 21 wherein a plurality of leading arms are mounted on the turning hub in an equally spaced pattern on a common radius centered on the center of rotation of the turning hub.

23. The devices of claims 1 to 8 and claims 11 to 22 wherein a plurality of trailing arms are mounted on the turning hub in an equally spaced pattern on a common radius centered on the center of rotation of the turning hub, and wherein the plurality of trailing arms comprise

the same total number of trailing arms as leading arms, and wherein the plurality of trailing arms are spaced apart from the leading arms at locations advantageous to the operation of the device.

24. The devices of claims 1 to 23 wherein an assembly of the elements of the claims comprises a turning unit.

25. The device of claim 24 wherein an array of turning units are spaced apart along the axis of rotation of the turning hub, and wherein the array of leading arms and the array of trailing arms are driven in unison so as to perform approximately simultaneous motions at all times.

26. The device of claim 25 wherein the array of turning units is designed and operated in such a manner as to cause boards to be inverted 180 degrees from an original position.

27. The device of claim 25 wherein the array of turning units is designed and operated in such a manner as to cause boards to be rotated ninety degrees from an original position.

28. The device of claim 25 wherein the array of turning units is designed and operated in such a manner as to cause boards to be dealt from a layer of stationary boards oriented edge to edge, one at a time into the spaces between lugs of the adjacent lugged conveyor.

29. The device of claim 28 wherein the array of turning units is designed and operated in such a manner as to cause boards to be inverted during the motion of dealing boards from the stationary layer of boards, one at a time into the spaces between lugs of the adjacent lugged conveyor.

30. The devices of claims 1 to 29 wherein the leading cam and the leading actuator are deleted and are replaced by an electronically controlled leading positioning actuator for the purpose of causing the leading pivot frame to be rotated about its pivot axis and thereby provide the coordinated motions of the leading arm as desired in time with the lugs on the adjacent lugged conveyor transfer.

30. The devices of claims 1 to 29 wherein the trailing cam and the trailing actuator are deleted and are replaced by an electronically controlled trailing positioning actuator for the purpose of causing the trailing pivot frame to be rotated about its pivot axis and thereby provide the coordinated motions of the trailing arm as desired in time with the lugs on the adjacent lugged conveyor transfer.

32. The devices of claims 1 to 30 wherein a turning unit includes two turning hubs.

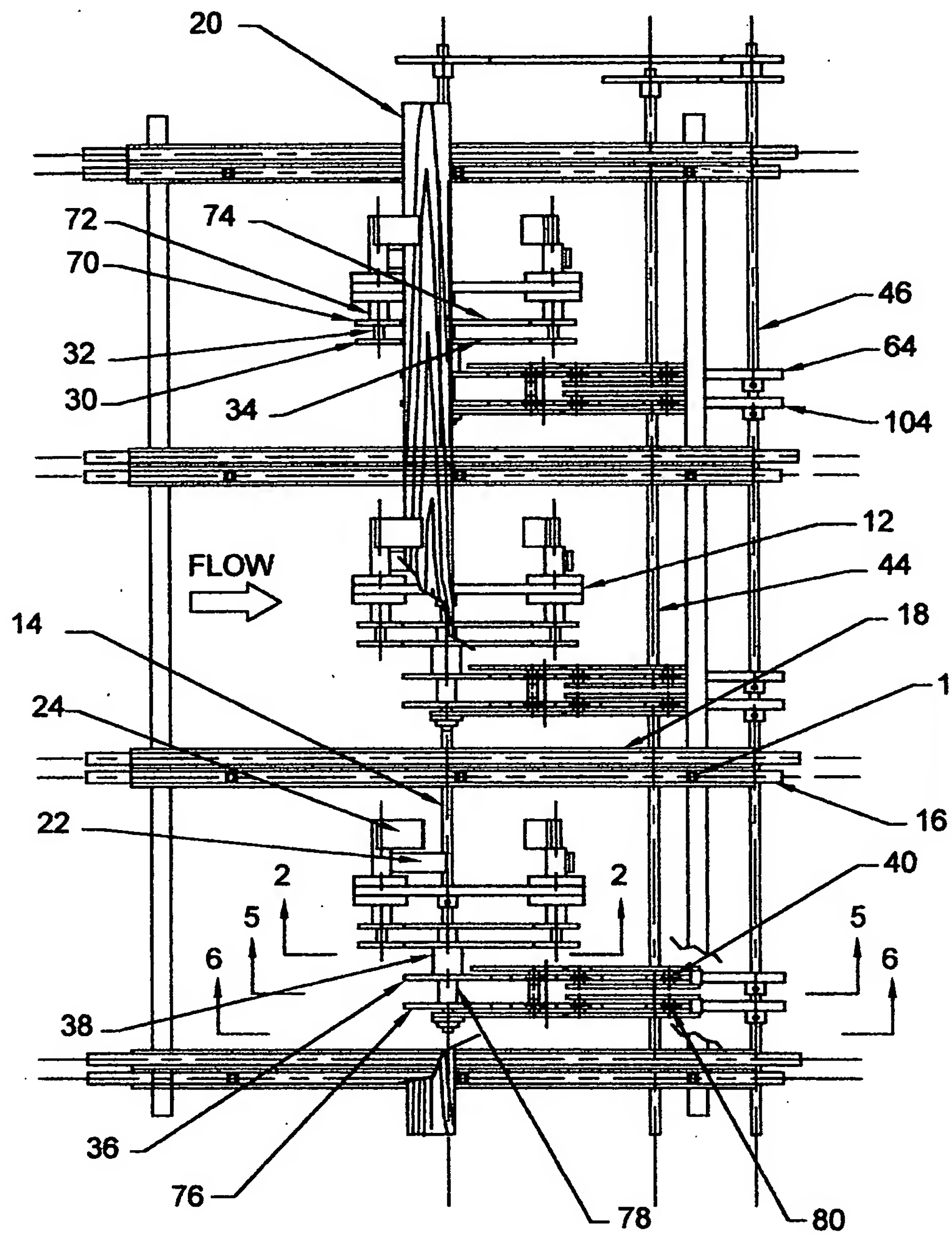

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Fig. 1

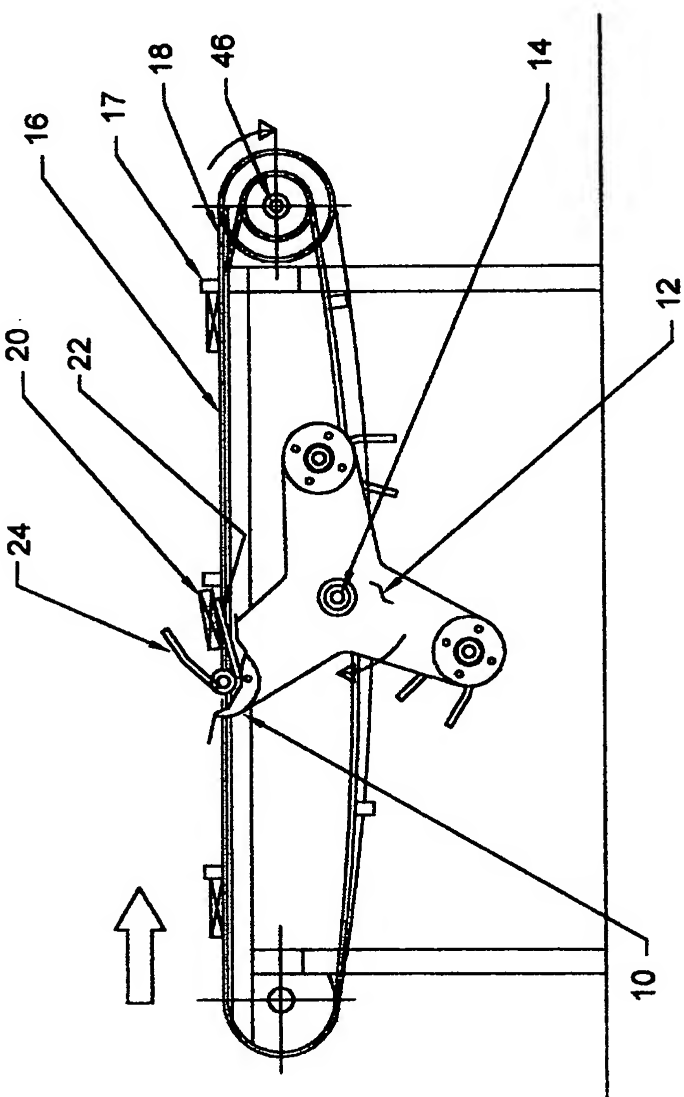


Fig. 2

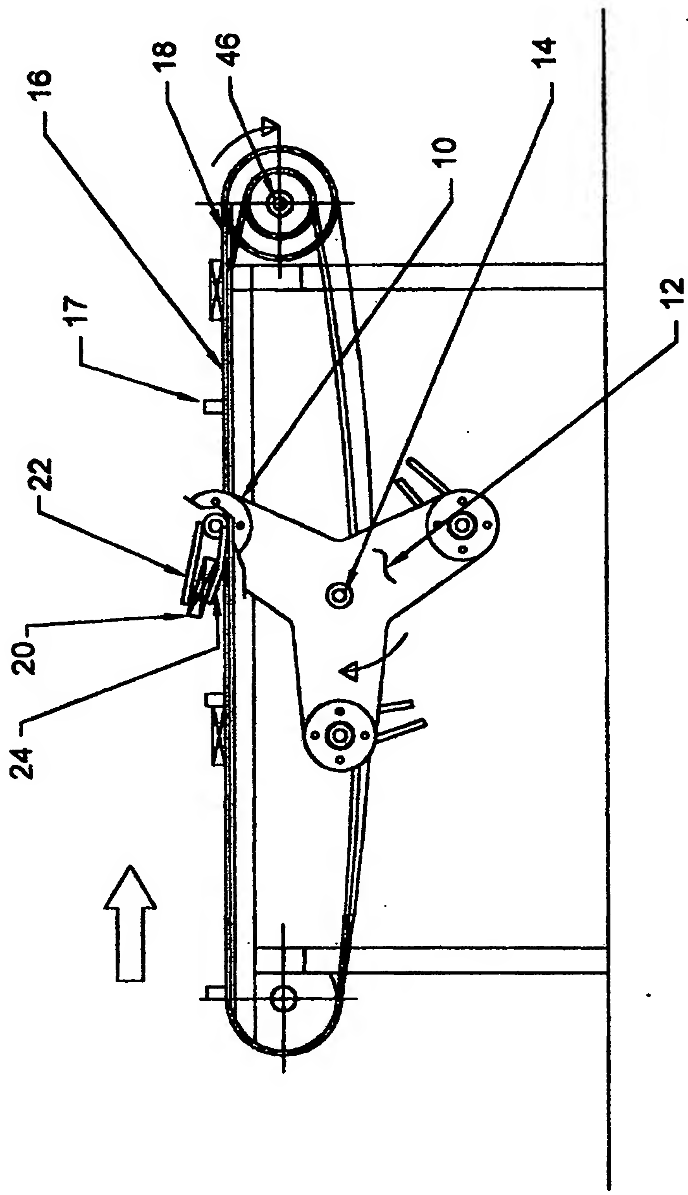
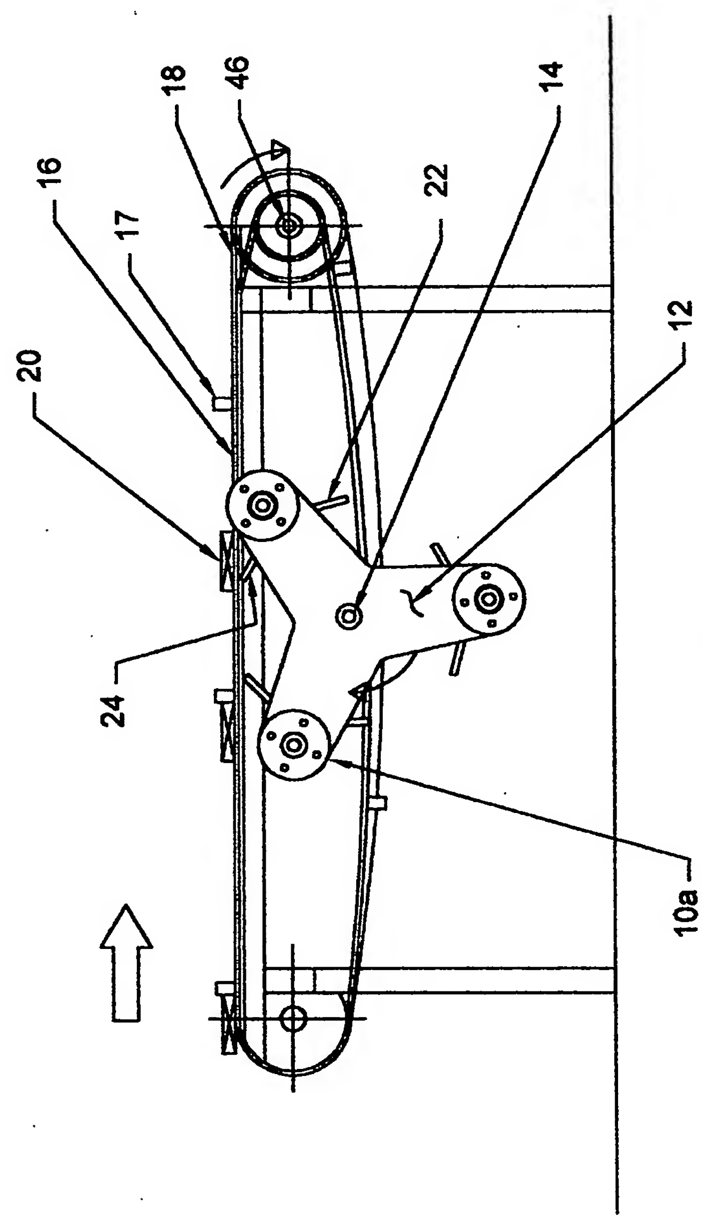


Fig. 3



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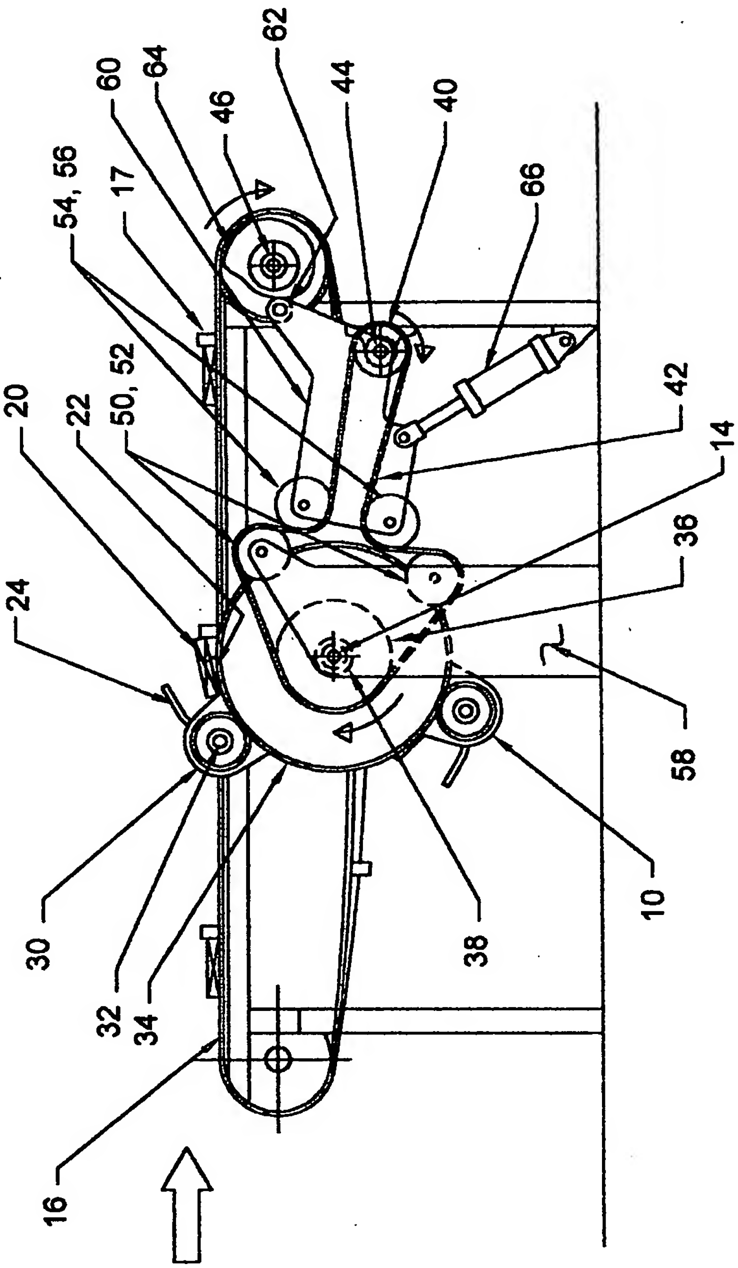
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Fig. 5

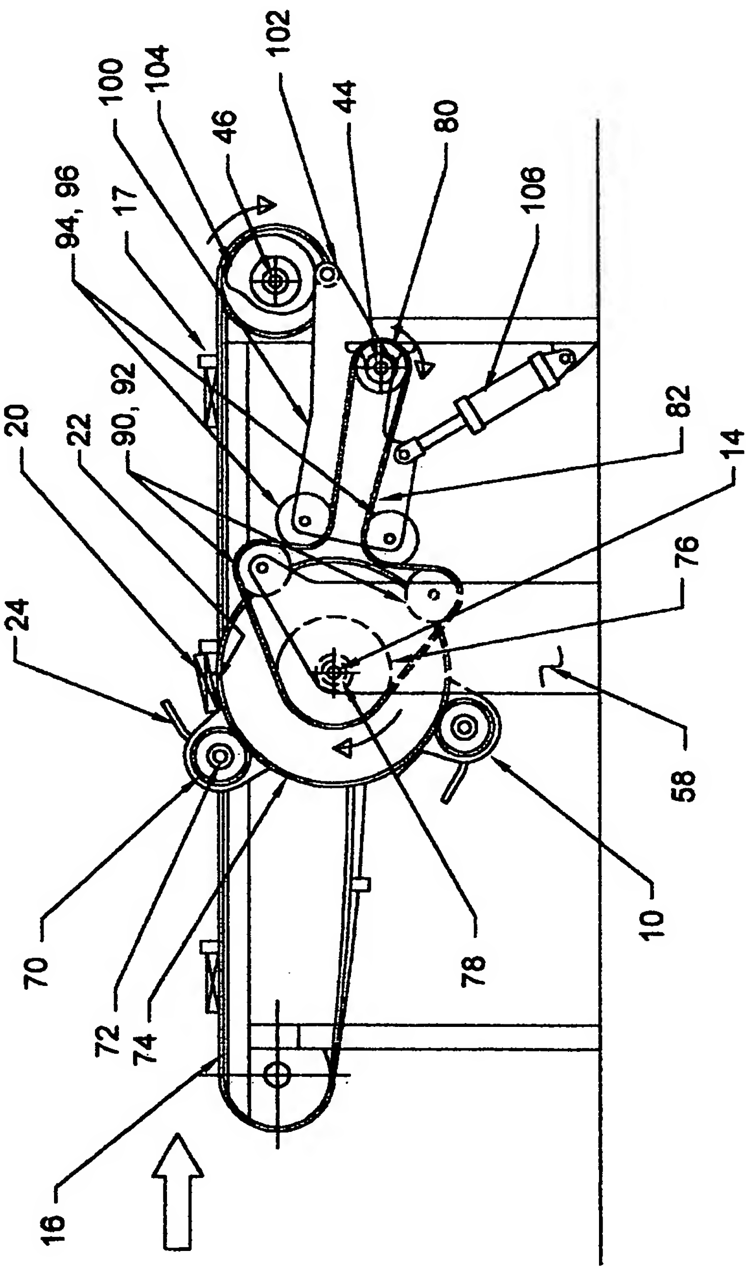

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Fig. 6

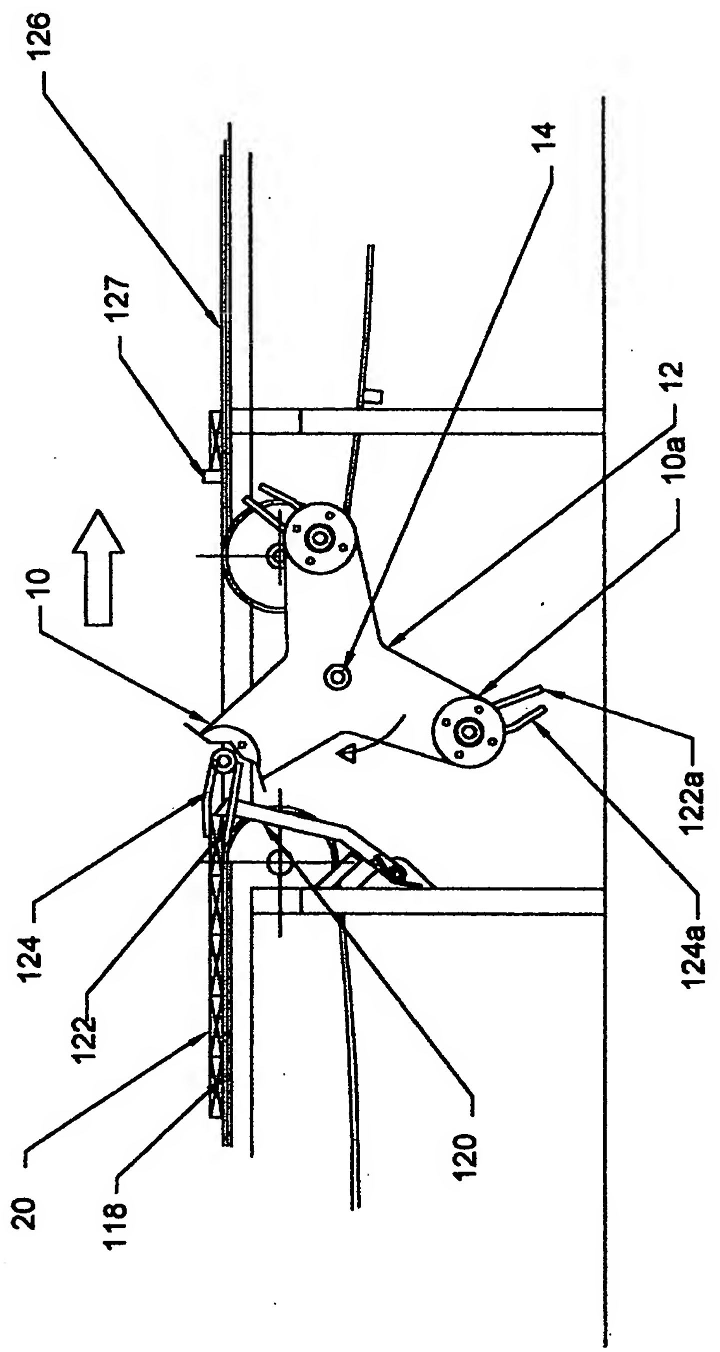
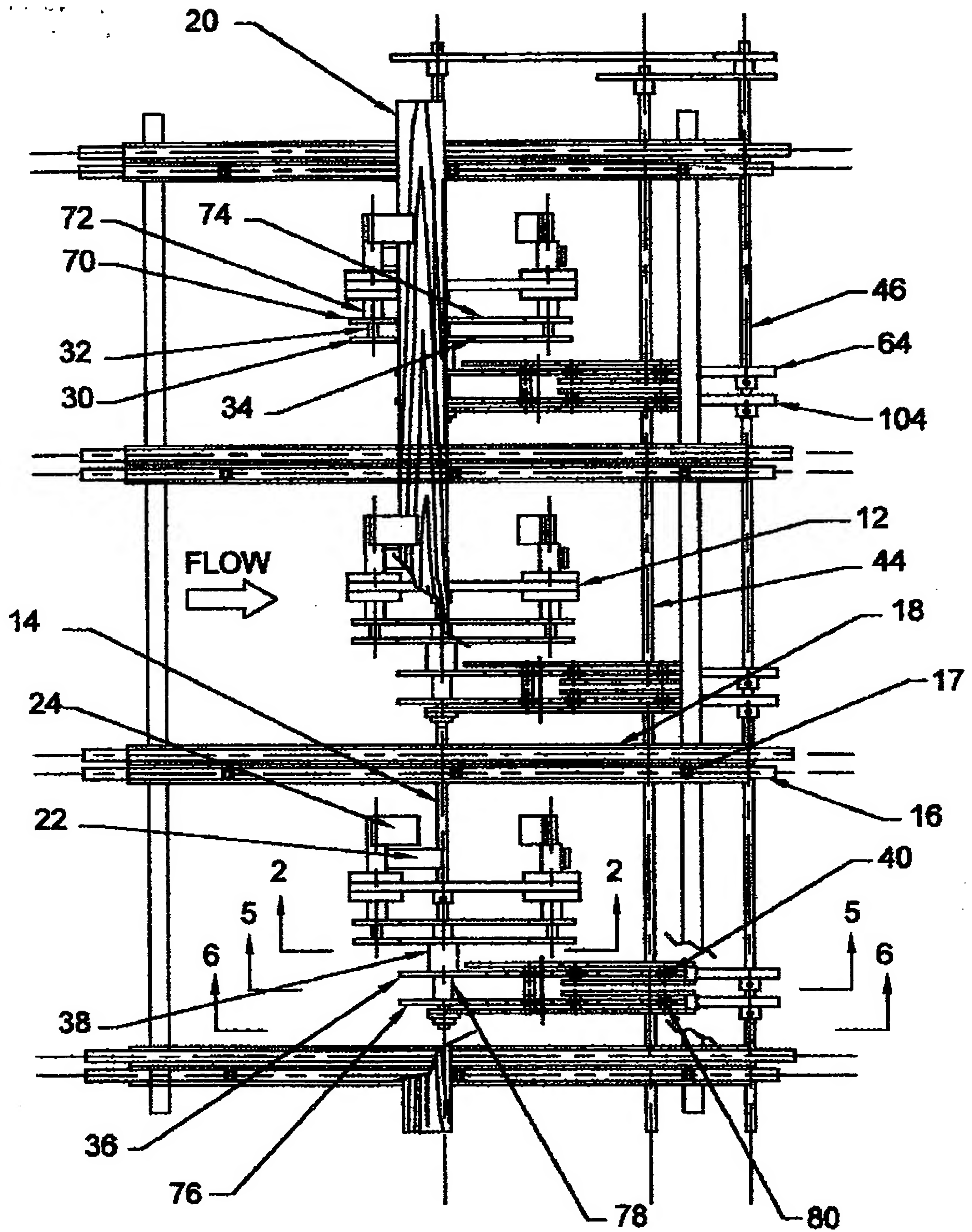


Fig. 7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